The Stratospheric Aerosol and Gas Experiment (SAGE III)

SAGE III's Role in EOS

SAGE III is a crucial element of NASA's Earth Observation System (EOS). Its mission is to provide accurate long-term measurements of the distribution of aerosols, ozone, water vapor, and other important trace gases throughout the upper troposphere and stratosphere. These measurements are vital inputs to the global scientific community for improved understanding of climate, climate change, and human-induced ozone trends.

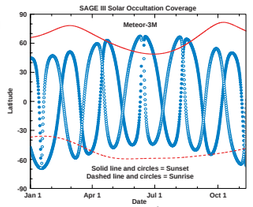
Missions

Three flights are currently planned for the instrument:

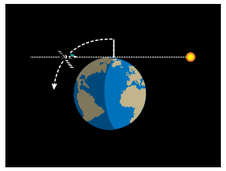
Meteor-3M
May 1999
Sun-Synchronous

International Space Station
2002
Inclined Orbit

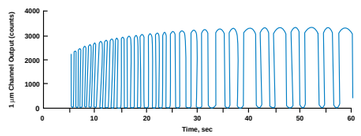
Flight of Opportunity
TBD
Inclined Orbit



Observation Strategy



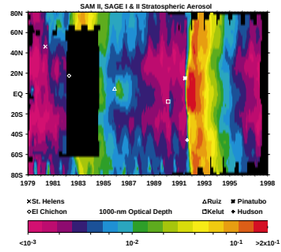
SAGE III employs the solar (lunar) occultation technique in which the brightness of the sun (moon) is observed as it is obscured (or "occulted") by the atmosphere. The brightness of an observation whose path passes through the atmosphere relative to that for paths which do not intersect the atmosphere is called the line-of-sight (or slant path) transmission.



The figure shows an example of a single channel's observations during a sunrise event. The shape of the sun's "profile" is modified by atmospheric attenuation, refraction, and the motion of the scan mirror relative to the movement of the sun.

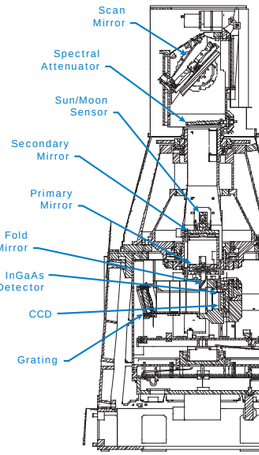
Design Heritage

Three SAGE III instruments are being built by Ball Aerospace & Technologies Corporation in Boulder, Colorado (USA). SAGE III is a fourth generation instrument that incorporates robust elements of its predecessors [SAM II, SAGE, SAGE II] while incorporating new design elements. The first of these (pictured at right) will be launched aboard a Russian Meteor/3M platform in May 1999. SAGE III will add measurements of O_2-A band from which density and temperature profiles are retrieved. This feature should improve refraction and Rayleigh computations over earlier. Additionally, the linear array of detectors will permit on-orbit wavelength calibration from observations of the exo-atmospheric solar Fraunhofer spectrum



Measurement Heritage

SAGE III is the latest member in series of solar occultation instruments that have already produced a nearly 20-year climatology of stratospheric aerosols and ozone. Since 1979, 1000-nm stratospheric optical depth (at left) has varied by a factor of ~100 as the result of volcanic eruptions like that of Mt. Pinatubo in 1991. SAGE III may help determine the role of human activities in the modification of the non-volcanic background aerosol level. A similar long-term climatology of stratospheric ozone is the focus of the current ozone assessments organized by SPARC (Stratospheric Processes and the Role in Climate) and UNEP (United Nations Environment Programme).

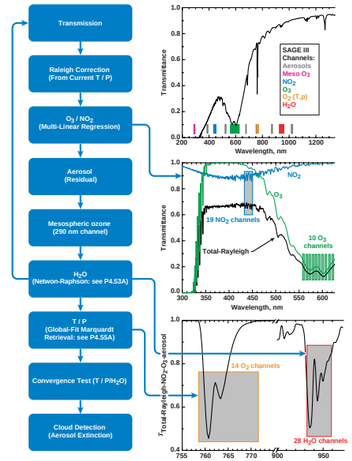


Instrument

SAGE III incorporates two new design elements: a CCD linear array of detectors and a 16 bit A/D converter; combined these new features allow wavelength calibration, self-consistent determination of the viewing geometry, lunar occultation measurements, and expanded wavelength coverage.

The spectrometer provides continuous wavelength coverage between 280 and 1030 nm at ~1-nm resolution. It permits the measurement of multiple absorption features of each gaseous species and multi-wavelength measurements of broadband extinction by aerosols.

Channel locations are fully programable. The nominal configuration consists of 12 wavelength bands (84 sub-channels) for the solar occultation measurements and 3 channels (340 sub-channels) in the lunar occultation measurements.



Algorithm

Line-of-sight (LOS) transmission profiles are determined at 84 wavelengths between 290 and 1550 nm with a vertical resolution of 0.5 km. The spectral variation of transmission (see left) is used to infer SAGE III data products. A complete description of the SAGE III algorithm can be found in the SAGE III Algorithm Theoretical Basis Documents (ATBDs) available at http://eospso.gsfc.nasa.gov/atbd/pg1.html

Data Products

Product Name	Accuracy* Absolute / Relative	Vertical Coverage
Aerosol Extinction at 8 Wavelengths (solar)	5% / 5%	0-40 km
H_2O Concentration	10% / 15%	0-50 km
NO_2 Concentration and Slant Path Column Amount	10% / 15%	10-50 km 10-50 km
NO_3 Concentration (lunar)	10% / 10%	20-55 km
O_3 Concentration Slant Path Column Amount	6% / 5%	6-85 km 50-85 km
OCIO Concentration (lunar)	25% / 20%	15-25 km
Pressure	2% / 2%	0-85 km
Temperature Profile (solar)	2K / 2K	0-85 km
Cloud Presence	N / A	6-30 km

Relative to its predecessor instruments, SAGE III offers:

- **Improved vertical range and accuracy for O_3, NO_2, and H_2O**
- **Decreased sensitivity for gas species to the presence of enhanced aerosol**
- **Aerosol extinction at 8 wavelengths (385, 449, 521, 676, 756, 869, 1019, and 1538 nm)**
- **Temperature and pressure measurements from 0-85 km**
- **Lunar (nighttime) measurements of O_3, NO_2, NO_3, OCIO**

Data Access

Routine data product distribution will be handled by the Distributed Active Archive Center (DAAC) at the NASA Langley Research Center (http://eosweb.larc.nasa.gov/). Access to the data server is available using html and X windows protocols. The DAAC is the archival center for SAM II, SAGE, and SAGE II.

SAGE III science team members and validation partners will have access to standard and preliminary SAGE III data products through a web-based server maintained by the SAGE III Scientific Computing Facility.

SAGE III Homepage

For more information concerning this project, visit the newly revised SAGE III homepage at (http://arbs8.larc.nasa.gov/sage3/). This site contains information about the instrument design, algorithms, and validation program.

This site will also act as the interface for the K-12 educational outreach program, "The Global Learning Sphere."

After the instrument becomes operational, the site will provide visitors easy access to browse SAGE III data products and validation activities.

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